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GOT RESIDUAL STRESS

ASM INTERNATIONAL RESIDUAL STRESS TECHNICAL COMMITTEE

Find Dale Ball'S Bio on Page 3.

DEVELOPMENT OF A RESIDUAL STRESS STANDARD

Written By
Dale Ball

In the past ten to fifteen years, significant progress toward the understanding and management of residual stresses in metallic structure has been made under the auspices of numerous Metals Affordability Initiative (MAI) projects, Small Business Innovative Research (SBIR) projects, USAF program funded projects, and many others. In January of 2020, the ASM International Technical Committee on Residual Stress formed a sub-committee on residual stress standards development, whose goal is to promote the development of standards and specifications for the measurement, modeling, understanding, and management of residual stress.

This activity has resulted in a draft AMS standard, the purpose of which is to provide uniform methods for defining, quantifying, and classifying the residual stress in metallic structural alloy products and finished parts. Such quantification and classification may be required when residual stresses within components can impact further in-process distortion during machining or other methods, and when residual stresses within components can impact final component mechanical properties and performance.

Full Article Link:

https://www.asminternational.org/home/-/journal_content/56/10192/45348759/NEWS

EVALUATION OF FORGING PROCESS INDUCED RESIDUAL STRESS IN ALUMINUM DIE FORGINGS

By Michael R. Hill et al.

Aircraft structural components are being produced from forgings with increasingly complex geometries in a wide range of aerospace alloys. The forging process involves a number of steps required to attain favorable material properties (e.g., heat treatment, rapid quench, cold work stress relieving, and artificial aging). These processing steps, however, also result in the introduction of bulk residual stress. Excessive bulk residual stresses can have negative consequences including: part distortion during machining and/or during service, reduced crack initiation life, increased crack growth rates, and an overall reduction in part life. This presentation will summarize recent work related to quantifying and accounting for residual stress in aluminum die forgings. Key residual stress engineering concepts will be described.

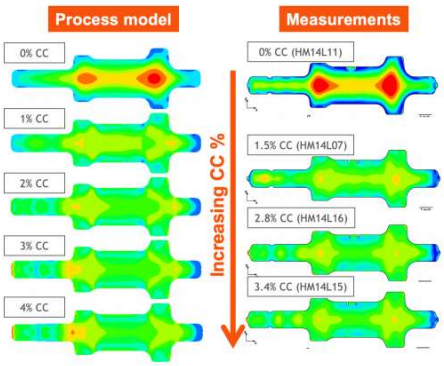

Figure 1: Residual stress at an exemplar forging cross section for different amounts of cold compression stress relief (CC) as determined by a process model and by contour method measurements [2]

Since the artifacts studied are associated with an aircraft supply chain (multiple parts and multiple lots), the results are relevant to the aerospace community. Overall, the results show that forging residual stress is a repeatable phenomenon with approximate repeatability less than 5% of A-basis yield strength.

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Professor Michael R. Hill is the incoming Chair of the ASM Residual Stress Technical Committee. Hill is on the faculty of Mechanical and Aerospace Engineering at University of California, Davis. He joined UC Davis in 1996 after having completed a Ph.D. in Mechanical Engineering at Stanford University (advised by Drew Nelson and Sheri Sheppard), and B.S. and M.S. degrees in Mechanical Engineering at the University of Arizona (advised by Paul Wirsching).

His professional work is dedicated to residual stress engineering, with published works in the areas of residual stress measurement, modeling, and fatigue assessment. Hill had a noteworthy impact on the development of laser shock peening through joint research and engineering with government and industry partners. That work established new engineering methods for measurement of residual stress and for the prediction of fatigue and fracture in residual stress bearing materials. His present research focuses on improving methods for measurement and control of residual stresses, and for proactively managing residual stress effects during design, manufacture, and fleet sustainment.

Hill is a Fellow of the American Society for Mechanical Engineers, active in the Society for Experimental Mechanics, and serves on the Steering Committee of the North American Residual Stress Summit, a premier conference on residual stress engineering and technology. He founded an industrial services firm in 2005, Hill Engineering, LLC, to solve difficult problems in structural materials, with a special emphasis on residual stress measurement and engineering.

UPCOMING CONFERENCES

IMAT 2021, Sept. 13-16, 2021
https://www.asminternational.org/web/imat-2021

ASM Heat Treat 2021, Sept. 14-16, 2021
https://www.asminternational.org/web/heat-treat/

Meca-SENS, Nov. 25-28, 2021
https://www.mff.cuni.cz/en/mecasens10

USAF ASIP, Nov. 29-Dec. 2, 2021
http://www.asipcon.com

ICRS 11, Dec. 2021
https://www.lanl.gov/contour/conferences.html

Aeromat 2022, Mar. 15-17, 2022
https://www.asminternational.org/web/aeromat-2022/home
*CFP by Sept. 30, 2021,
https://www.asminternational.org/web/aeromat-2022/cfp

SEM , Jun. 13-16, 2022
https://sem.org/annual

Fatigue 2022, Oct. 17-22, 2022 (Hiroshima)
https://www.showsbee.com/fairs/Fatigue-Congress.html

North American Residual Stress Summit, not until 2022
https://www.lanl.gov/contour/conferences.html

ECRS 2022, TBD
https://www.lanl.gov/contour/conferences.html

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Dale Ball is a senior fellow in the area of fatigue, fracture and sustainment methods development, and test at Lockheed Martin Aeronautics Co. in Fort Worth, TX.

Dale currently serves as a principal engineer for service life analysis methods, and as a principal investigator on numerous IRAD and CRAD projects, on topics ranging from fracture mechanics of cold expanded holes, to forging residual stress effects, to strain-based fatigue life prediction.

He has supported a variety of programs during his 39 year career, ranging from the B-2 and NASP, to the F-111, F-16, F-22 and now F-35 programs.

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